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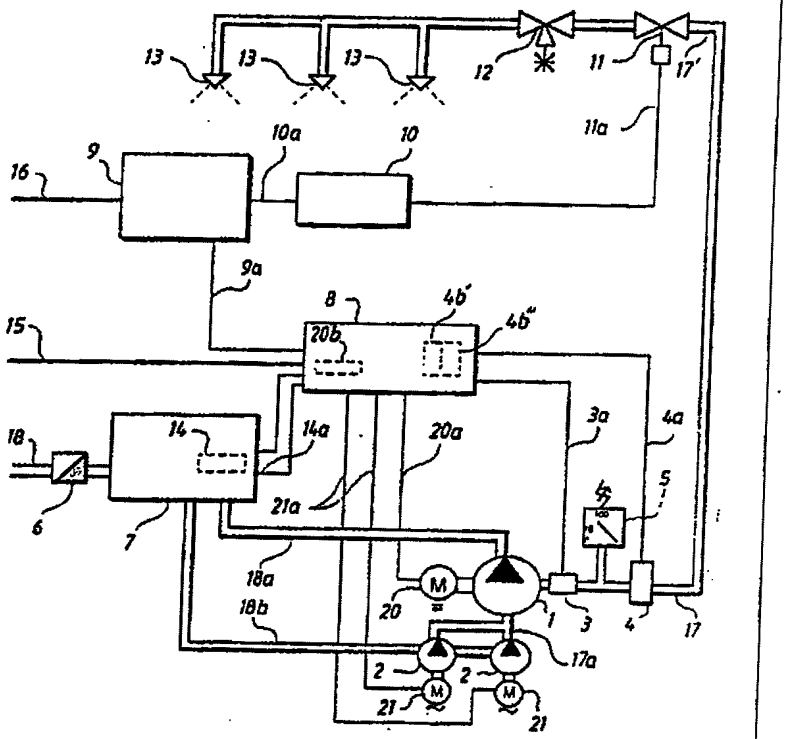
(54) Title: METHOD OF OPERATING A SPRINKLER INSTALLATION AND A DEVICE FOR EXECUTING THE METHOD

(57) Abstract

A pump device for feeding a sprinkler system comprises a speed controlled, D.C. driven mother pump (1) which continuously maintains a stand-by pressure in the sprinkler system, and at least one slave pump (2) which is switched on when, after alarm has been given, the performance of the mother pump in maintaining the stand-by pressure has reached a predetermined part of its maximum value. The performance of the mother pump is then reduced to a predetermined lower level, and the slave pump or pumps are stopped when no more needed.



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Method of operating a sprinkler installation and a device for executing the method

The invention refers to a method for operating a sprinkler installation for fighting fire and which comprises an alarm device, a plurality of spray heads provided with thermal fuse elements, a pump device comprising at least one sprinkler pump which is adapted to discharge, upon a signal from the alarm device, water in a volume and with a pressure which are needed for the function of the sprinkler device, and a tubing (piping) system connecting the the pump device with the spray heads.

With "spray head" is in the present specification and in the annexed claims understood a means for discharging water in the form of jets or fog. With "thermal fuse element" is understood a means which triggers the respective sprinkler head when a predetermined elevated temperature is reached; it is generally a glass bulb which bursts by heat.

The invention refers also to a device for executing the method.

In conventional sprinkler installations for fighting fire, water for extinguishing the fire is discharged from the spray heads in jets, whereto relative large quantities of water are needed. The sprinkler pumps are driven by an electric motor, and in a known sprinkler system they are driven so, that the tubing system is constantly filled with with low pressure water (having the pressure of the water in the mains, i.e. 4 to 5 bars, which thus constitutes the stand-by pressure of the sprinkler installation).

For compensation of little leakages comprises the pump device besides of the sprinkler pump a pressure stabilizing pump having only a small capacity (discharging a smaller flow than what is necessary for a single spray head) and delivering a maximum pressure (e.g. 6 to 7 bars) which lays only slightly above the stand-by pressure. The pressure stabilizing pump is driven by a pressostat and is constantly switched on.

The sprinkler pump and the tubing system with its pipe flanges etc. are designed for a maximum pressure in the order of 10 bars, which is the conventional operational pressure of the system.

When one or more of the spray heads are triggerd after the respective glass bulb has bursted, the pressure in the tubing system decreases rapidly and the sprinkler pump is automatically started to provide the whole sprinkler installation with water for extinguishing the fire. In this connection is the pressure (10 bars) of the water delivered to the spray heads of smaller importance than what a sufficient flow is, because from each spray head are 60 to 180 litres ejected each minute. The tubing system must have a sufficiently large diameter for such a flow.

The starting up of the sprinkler pump is however somewhat delayed (e.g. appr. 40 to 50 seconds), which is obviously a serious drawback. The reason for the delay is that the alarm valve, which operates as a check valve between the holder of the sprinkler and the sprinkler pump, needs appr. 40 second to lift,
i.e. to give alarm, and then it takes appr. 10 seconds for the automatics (Y-D start) to generate full pressure in the pump.

It is an object of the present invention to provide a method and a device in which the pressure stabilizing pump may be omitted, the tubing system may have a smaller diameter, and the delay at the start does not occur.

These objects are achieved according to the invention in a way which is evident from the enclosed claims, by "high pressure pump" being there understood a pump which can deliver a pressure 10 to 20 times higher than what the pressure in a conventional sprinkler pump is, i.e. a pressure in the order of magnitude of 100 to 200 bars.

According to the invention, the high pressure pump with regulated rotation speed delivers only the volume of water which is instantly consumed, i.e. discharged by the spray heads, without the necessity of ever to return any quantity of water to the pump. This is different from pumps with unvariable capacity, in which discharged water which is not consumed is recycled ("by-passed) to the pump, with the

result that spill heat is generated.

Upon the start of a high pressure pump appears, however, the disadvantage that in a tubing system which is not, or not completely, filled with water, the air comprised therein is compressed so that violent pressure strokes ("hammer stroke effect") come up, which may cause that the whole tubing system is shaken down after a time. By the tubing system being according to the present invention constantly kept free of air and filled with water with stand-by pressure, e.g. 10 bars, no pressure strokes occur when the pressure is increased to the operational value of between 100 and 200 bars.

Thus, water with the high operational value is present in the spray heads as soon as an alarm has been given, but it is held back by the glass bulbs, and sprinkling commences only after these bulbs have bursted due to the effect of heat.

This means that no sprinkling occurs when a false alarm has been given, i.e. when an alarm signal (triggered e.g. by smoke) is not followed by development of heat. The operational pressure, i.e. the increased rotation speed, can be put back manually.

Preferably one takes (programs) further the disposition that the rotation spped of the pump, and thus also the water pressure, is increased to the higher values even when the alarm device of some reason becomes unoperational, because this possibly may be caused by a circumstance which may involve the risk of fire. Sprinkling begins even in such a case only if and when the glass bulbs have burst hy heat.

When in the fire centre a signal is received which indicates that some detector has been removed or is out of order, a signal is sent to the control member of the pump ("the control box") to increase the pressure to the operational value. If the connection (line) between the fire centre and the control member of the pump is severed, a signal is also sent to the control member of the pump by an activated relay in the control box being dropped which is fed externally (i.e. not from the source of current feeding the alarm system). This occurs even at a normal fire alarm. The circuit

is fed by the relay voltage.

Should all these signals be absent, pressure is increased to the operatoional value as soon as a glass bulb bursted, i.e. as soon as a flow comes about, which is sensed by a flow sensor in the out-line of the pump, or is measured on the armature voltage of the motor of the pump.

In a preferred embodiment of the invention, the pump device comprises besides of the sprinkler pump, which operates as a mother pump, one or several (e.g. 8) slave or additional pumps which are drivable with constant speed and which, once started, operate at full effect. The purpose of the additional pumps is to increase the water capacity while the mother pump, reduced e.g. to 25% of its performance, continues as before to control the pressure and the flow until the additional pump or pumps no longer are needed. Then the additional pump or pumps are stopped and only the mother pump continues to operate, if needed even at its full capacity.

While it is in principle possible to use as the high pressure pump with variable speed also an aggregate consisting of a motor rotating with unvariable speed plus a separate speed controller, in a preferred embodiment of the invention the high pressure pump is embodied by a pump driven by a thyristor-controlled D.C.-motor.

The invention will now be explained more in detail with the aid of an exemplary embodiment according to the enclosed drawing which is a diagram in which water conduits are shown by double lines and electric connections by single lines.

A high pressure pump 1 is driven by a thyristor-controlled D.C.-motor 20 with variable speed and is fed from a mains water line 18 by way of a water filter 6, a (pressure free) break tank 7 and in-line 18a.

Through an out-line 17 which is embodied by a high pressure conduit, and in which a flow sensor 3 sensing the flow, and a transducer 4, sensing the pressure, are arranged, is pump 1 connected to a plurality of fog spray heads 13 which are provided with heat sensitive triggers known per se, such as glass bulbs. The pressure in the out-line 17 is indicated on a display instrument 5.

In the line 17, more correctly in a branching 17'thereof, leading to the fog spray heads 13, is a closing valve 11 and a run-off valve 12 for the fog sprinkling water provided.

Besides of the pump 1, there as a plurality (in practice e.g. 8) additional pumps 2 provided which are driven by A.C.motors 21 and which through a line 18b are fed with water from the main line 18, more correctly from the break tank 7. The out-lines of the additional pumps 17a are connected to the line 17 via the main or mother pump 1.

The electrical motors 1 nad 2 are through electric lines 20a and 21a fed with current from a central control means (control box) 8 to which feeder current is brought via a line 15. The flow and pressure values, sensed by the sensors 3 and 4, are fed into the control box 8 through lines 3a and 4a, and via a line 14a is information about the water level in the break tank 7, in which a level sensor 14 is provided to this purpose, fed into the box 8. In the control box 8 are further provided, among other things, two rotary potentiometers 4', 4" for setting the two pressure values (stand-by pressure and operational pressure), and a thyristor bridge 20b for controlling the motor 20.

A fire alarm centre 9 is by an alarm line 16 connected with (smoke or heat sensitive) fire detectors (not shown) which are distributed in the space which shall be monitored, and by a line 9a is the fire centre 9 connected to the control box 8.

The closing valve 11 is by a line 11a connected to a programable logical system (PLS) 10 for the control of valves, which system is in its turn via a line 10a connected the fire alarm centre 9.

PLS can be programmed so as to upon a fire open a closed valve (e.g. valve 11) in the section in which the valve is located, or a closed valve which controls the flow to a large space (e.g, a restaurant) where everthing shall be fog-sprinkled at the same time (so called "deluge").

When the firemen have arrived, they take care of the extinguishing operations with their own means and sprinkling is no longer either needed or desired. The valve

is then closed either manually or by the PLS 10 being programmed after some time (e.g. 4 minutes) again to close the previously opened valve. When the valve is closed, the flow decreases and the additional pump or pumps are no longer needed.

The installation operates in the following manner. The high pressure pump 1 is continously driven by the motor 20 with a speed which results in the line 17 in pressure of e.g. 10 bars, the stand-by pressure of the sprinkler installation, and the valve 11 is open. The motors 21 and the pumps 2 are at rest.

When a fire alarm arrives through the line 16, it is received by an interface in the control box 8 and the speed of the mother pump is so controlled by the thyristor bridge 20b that the pressure in the tubing system increases to and is kept at the predetermined operational pressure value, e.g. 100 bars, the flow being allowed to vary.

This pressure spreads swiftly to the fog spray heads 13, which, however, do not begin to work before their thermofuse elements have been affected, i.e. the glass bulbs have bursted. Consequently, high pressure is already "on place" in the fog spray heads when this occurs.

When the pressure sensor 3 continuously "reports" to the control box 8 that the pressure in the line 17 has a lower value than the predetermined operational value which is set on one of the rotary potentiometers 4b', 4b" (e.g. 100 bars), the speed of the mother pump 1 is increased till the operational pressure is attained or, if the mother pump has attained a predetermined part of its maximum performance (e.g. 75% thereof), a signal is generated in the control box 8 that a first additional pump 2 shall start, and at the seme time a signal is given to the motor 20 to reduced the rotation speed to a predetermined lower value (corresponding e.g. to 25% of the maximum performance of the mother pump 1).

If the mother pump 1 with the first additional pump 2 running again reaches said predetermined performance value (e.g. 75%), additional pump number two is started, and at the same time a signal is given to mother pump 1 to attain again the predetermined second reduced value (e.g. 25% of the

maximum performance). This procedure is repeated as often as necessary, until possibly all additional pumps are running. The additional pump are thus consecutively started one after the other, the second after the mother pump after the the start of the first one again has reached the predetermined part of its maximim capacity, etc., etc.

The mother pump regulates now the rotation speed of the whole system so that correct pressure and flow is achieved, and to the spray heads 13 flows water as well from the mother pump 1 through the line 17, as from the additional pumps 2.

If, because of some reason, the fire alarm from the detectors may not be coupled to the mother pump 1, this pump is activated when, and by the fact that the thermal fuse element (glass tube) in any of the spray heads is destroyed. The first water which then comes out from the spray head has only stand-by pressure, i.e. 10 bars for instance, but as soon as a flow comes about in the line 17 and is sensed by the flow sensor 1, a signal is generated to increase the rotation speed of the motor 20 so that the pressure increases to its operational value, e.g. 100 bars.

The purpose of the at least one additional pump 2 which goes for full after having ben started is to increase the water capacity. The flow and the pressure in the line 17 continue to be regulated, as before, by the mother pump 1 (reduced to 25% performance) until the additional pump or pumps 2 no longer are needed, as mentioned before. Then it or they are stopped and only the mother pump 1 operates.

The advantage of using one or more (e.g. 8) non speed- regulated, D.C.-driven and direct-started additional pumps which are connected to the speed regulated mother pump is the low price of available pump capacity and a simple and non expensive storage of replacement parts.

The additional pump or pumps may also be used as spare pumps and be individually started, thus increasing the fire security.

Claims

1. A method of operating a sprinkler installation for fire fighting, comprising an alarm device, a plurality of spray heads provided with thermal fuse elements, a pump device controlled by a control member, and a tubing system connecting the pump device with the spray heads, the pump device comprising at least one sprinkler pump driven by an electric motor and arranged to maintain, in the stand-by condition, the tubing system filled with water having a lower, stand-by, pressure and, when an alarm signal, generated in the alarm device, appears, to feed into the tubing system water in a quantity necessary for the extinguishing function of the spray heads and with the necessary higher operaing pressure, **characterized** in that the sprinkler pump in the pump devise is embodied by a high pressure pump with variable rotation speed, so that by variation of the rotation speed the volume and/or the pressure of the water fed into the tubing system is variated, the pump device being normally driven at a lower first speed so that the pump device, when the stand-by pressure in the tubing system decreases, as a pressure stabilizing pump maintains said pressure at its preselected value, and upon appearence of said alarm signal is driven at a higher rotation speed so as to create in the tubing system the flow for the extinguishing function of the sprinkler installation and/or the higher operational pressure, e.g. 100 to 200 bars which is necessary to this purpose.

2. The method of claim 1, **characterized** in that the spray heads are made fully operational immediately after having been triggered due to the fact that the pressure in the tubing system is by said speed increase augmented to the operational value already before the thermal fuse elements have bursted.

3. The method of claim 2 or 3, **characterized** in that a flow and/or pressure sensor, connected to the control member of the pump device, is provided in the tubing system, and that the pump device further comprises at least one additional pump which is driven at unvariable rotation speed and which is automatically started when the capacity of the mother pump, sensed by a flow and/or pressure sensor, is utilized to a predetermined part of

its maximum value, the capacity of the mother pump being at the same time reduced by decreasing the rotation speed to a smaller part of its maximum value.

4. The method of claim 4, characterized by the fact that when a plurality of additional pumps is present, they are started one after the other so that the second one is started when the mother pump again has reached the predetermined part of its maximum capacity after the first additional pump had been started, etc. etc.

5. The method of claim 3 or 4, characterized in that the additional pump or pumps are stopped when they no longer are needed due to decreased flow demand, the mother pump continuing to operate alone, possibly at maximum capacity.

6. A method according to one or more of the preceding claims, characterized in that the stand-by pressure is in the order of magnitude of 10 bars, the operational pressure is in the order of magnitude of 100 to 200 bar, and the possibly applicable two predetermined parts of the maximum capacity of the mother pump are in the order of magnitude of 75% and 25% respectively.

7. A device for operating, according to the method of one or more of the preceding claims, a sprinkler installation for fighting fire, comprising an alarm device, a plurality of spray heads (13) provided with thermal fuse elements, a pump device controlled by a control member (8), and a tubing system (17, 17') connecting the pump device with the spray heads, the pump device comprising at least one sprinkler pump (1) which is driven by an electric motor and is arranged to constantly maintain the tubing system filled with water with a lower, stand-by, pressure and, when an in the alarm device generated alarm signal comes up, to feed into the tubing system water with a higher, operational pressure, necessary for the extinguishing function of the spray heads, in a quantity necessary for the said extinguishing function,

characterized

in that in the pump system is as the sprinkler pump installed a high pressure pump with variable rotation speed, and that the control member is arranged to maintain, in the stand-by condition, this speed at a setting to a lower value corresponding to a

preselected lower value of the stand-by pressure of the water which is being fed out, and upon reception of an alarm signal or start signal to increase the rotation speed to a second, higher value corresponding to a preselected second, higher pressure value of the water which is being fed out.

8. The device of claim 7, **characterized** in that the pump device further comprises at least one slave pump or additional pump (2) which is drivable with unvariable rotation speed and which has a lower capacity, and that the control member is adapted to start the additional pump or pumps when the capacity of the sprinkler pump, operating as a mother pump, has reached a predetermined part of its maximum value.

9. The device of claim 8, **characterized** by the control member being adapted to decrease the performance of the mother pump to a predetermined smaller part of its maximum value, and to stop the additional pump or pumps when they no longer are needed.

10. The device of claims 8 and 9, **characterized** by rotary potentiometers (4b', 4b") for setting the said two parts of the maximum capacity of the mother pump.

11. The device of claim 8 or 9, **characterized** by the mother pump being driven by a D.C. motor (20) with variable rotation speed, and the possibly present additional pump(s) being driven by an A.C. motor (21).

12. The device of one or more of the claims 7 to 11, **characterized** by the capacity of the additional pump or pumps being in the order of magnitude of half of the mother pump's capacity.

13. The device of one or more of the claims 7 to 12, **characterized** by a pressure sensor (4) and/or a flow sensor (3) being provided in the tubing system, the output signals of which are fed into the control member.

14. The device of one or more of the claims 7 to 13, **characterized** by a display instrument (5) for indicating the pressure in the water which leaves the pump device.

15. The device of one or more of the claims 7 to 14, **characterized** by a sensor adapted to set the value of the operational pressure when the detector and/or alarm system is non operative.

16. The device of one or more of the claims 7 to 15, characterized by the spray heads being fog spay heads.

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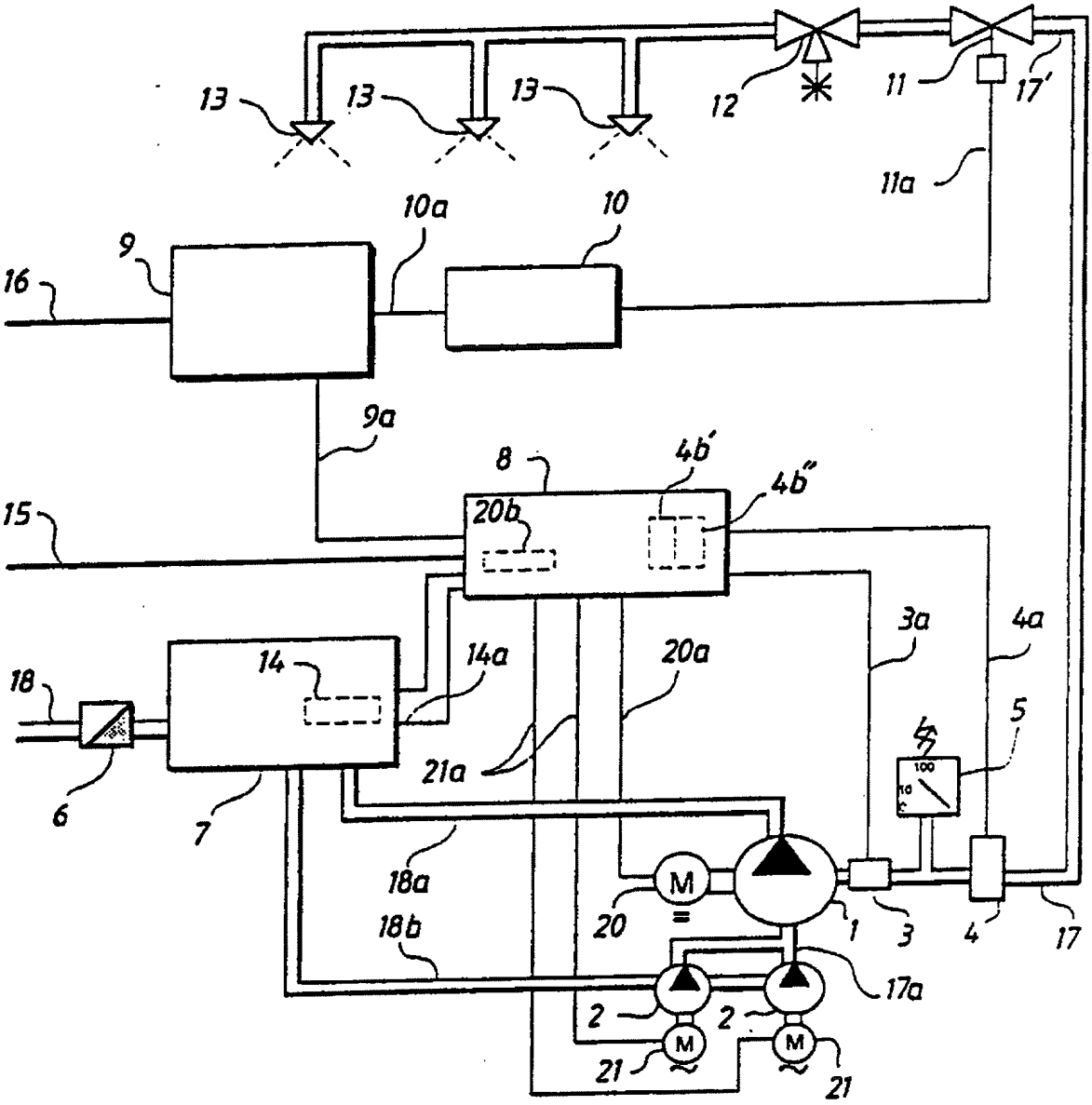

SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 94/00366

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: A62C 35/00, A62C 35/60, A62C 37/36, A62C 37/40
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: A62C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO, A1, 9222353 (SUNDHOLM, GÖRAN), 23 December 1992 (23.12.92) --	1
A	WO, A1, 9219324 (SUNDHOLM, GÖRAN), 12 November 1992 (12.11.92) --	1
A	Derwent's abstract, No H8307 B/37, week 7937, ABSTRACT OF SU, 635998 (MOSC CONUEN EXP DES), 10 December 1978 (10.12.78) --	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 August 1994	11 -08- 1994
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ulrika Öhman Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

02/07/94

International application No.
PCT/SE 94/00366

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A1- 9222353	23/12/92	AU-A- 1327192	06/10/92
		AU-A- 1971492	12/01/93
		BR-A- 9205688	17/05/94
		CA-A- 2111232	23/12/92
		EP-A- 0589956	06/04/94
		FI-A,D- 935717	14/02/94
WO-A1- 9219324	12/11/92	AU-A- 1656492	21/12/92

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(56) Documents Cited
US 4366865 A

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UK CL (Edition M) A5A A14B A14H A16
INT CL[5] A62C 35/00 37/00
ON LINE DATABASES: WPI and CLAIMS

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(54) Fire sprinkler systems

(57) System has break tank means for water supplied to the system from a water main, at least one sprinkler, and pump means for supplying water from the break tank means to the sprinkler or sprinklers, the pump means being arranged to he operated so as to provide for supply of water to the sprinkler(s) at a flow rate substantially not greater than a predetermined flow rate.

GB 2 280 368 A

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

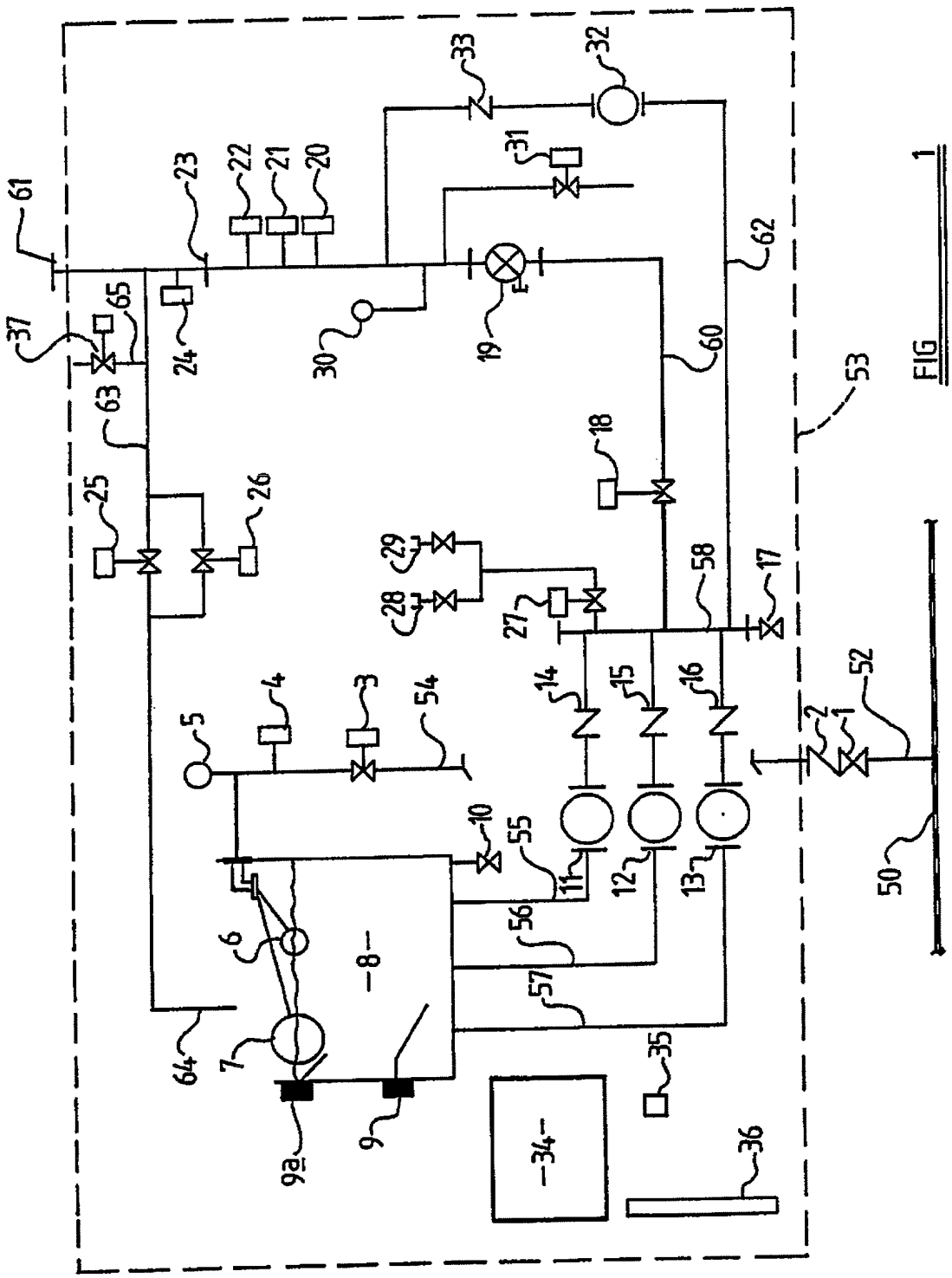
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FIG 1

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PATENTS ACT 1977

TITLE: **Fire Sprinkler Systems**

Description of the Invention

This invention relates broadly to fire sprinkler systems, and more particularly to the supply of water to fire sprinkler systems from water mains.

Fire sprinkler systems are well established as an effective means for the protection of buildings from fire. Sprinkler systems are also used for the fire protection of industrial plant and machinery installations, whether or not such installations are disposed within buildings. A typical sprinkler system includes a number of suitably positioned sprinklers of a type which is caused to commence operating upon detection, e.g. by melting of a fusible element, of the existence of a temperature of a predetermined level higher than normal ambient temperatures encountered at the sprinkler location, and the necessary pipes for supplying water to the sprinklers.

It is usual to supply a sprinkler system with water from a water main. It is of course essential that the main should be able to supply water to the system at sufficient pressure to ensure satisfactory operation of the sprinklers and at a flow rate (volume ÷ time) to supply all the sprinklers which have been brought into operation. It will be appreciated that for many fires not all the sprinklers of a system will be brought into operation as the operation of a sprinkler or sprinklers first brought into use will prevent spread of the fire beyond the area protected by such sprinkler(s).

One problem with the supply of water from mains to sprinkler systems is that water supply authorities are endeavouring to reduce mains water pressure to the minimum value which they are legally obliged to supply. The purpose of such reduction in pressure is to reduce waste of water by leakage from mains. Whilst the ability of most mains is still adequate to meet the flow rate requirements of sprinkler systems, in many cases the pressure will no longer be

sufficient for satisfactory operation. A further problem with reduction of mains pressure is that it is common to provide sprinkler systems with a means for detecting when one or more sprinklers are brought into operation by identifying a drop in pressure which occurs at a point or points in the system when one or more sprinklers commences operation. Such identification of sprinkler operation evidenced by pressure drop is used to provide an automatic signal to call out the fire brigade to the premises concerned. Reduced mains pressure can lead to false alarms which clearly is undesirable. Some water supply authorities bring in additional pumping machinery to increase mains pressure when there is a fire, but whilst this solves the problem of satisfactory sprinkler operation it does not eliminate the problem of false alarms if the prevailing mains pressure at normal times is low.

The standard method of providing a sprinkler system when mains pressure is low is to install a relatively large water storage tank and pumps to supply the sprinklers from such tank. The difficulty then is the necessary building and installation work for the tank and the space occupied thereby. Such a system incorporating a large storage tank is expensive.

It is broadly the object of the present invention to overcome or reduce the problems above described. Other objects and advantages of the invention will be pointed out more particularly hereafter.

According to one aspect of the present invention, we provide a fire sprinkler system comprising:

means for connection to a water main, for supply of water to the system;

break tank means for receiving said water;

at least one sprinkler;

and pump means for supplying water from said break tank means to said at least one sprinkler;

wherein said pump means is arranged to be operated so as to provide for supply of water to said at least one sprinkler at a flow rate substantially not

greater than a predetermined rate. Preferably said predetermined rate is the minimum sustainable flow rate of water available from said main.

According to another aspect of the present invention, we provide a method of operating a fire sprinkler system comprising means for connection to a water main, for supply of water to the system; break tank means for receiving said water; at least one sprinkler; and pump means for supplying water from said break tank means to said at least one sprinkler; said method comprising operating said pump means so as to supply water to said at least one sprinkler at a flow rate substantially not greater than a predetermined rate.

Preferably said predetermined rate is the minimum sustainable flow rate of water available from the main. Such minimum sustainable flow rate may be ascertained by enquiry of the water supply authority, by carrying out a test, or possibly by the provision of a device which is able to assess continuously or at intervals what is the minimum sustainable flow rate of water available from the main.

In a system according to the present invention, because the delivery of the pump means is substantially not greater than the ability of the water main to supply water, there is no need for a storage tank of high capacity. Whilst the break tank means of a system according to the invention provides storage for a quantity of water, such quantity can be relatively small, e.g. of the order of 2 cubic metres.

Preferably the system includes means for measuring the pressure and/or flow rate of water in a pipe leading to the at least one sprinkler, and means for controlling operation of the pump means in accordance with the flow rate and/or pressure thus measured.

The pump means preferably includes a pump operable to pressurise water in said pipe leading to the at least one sprinkler when no sprinklers are in operation, change of such pressure in the pipe providing an indication of operation of the bringing into operation of a sprinkler or sprinklers.

For supply of water to the sprinkler or sprinklers when in operation, the pump means may include a number of pumps, for example three, of which one or more are arranged to be brought into operation according to the number of sprinklers operating. Typically 90% of fires likely to occur in an area covered by a sprinkler system according to the invention will bring only one or a small number of sprinklers into operation whose water demand can be met by one pump. With three pumps, there are then two pumps in reserve. 95% of possible fires will bring into operation a number of sprinklers whose water demand can be met by operation of two pumps, whilst the operation of three pumps will meet the water demand of sprinklers operated by 98% of possible fires. Whilst it is always possible that a large fire could break out, bringing into operation a large number of sprinklers whose water demand cannot totally be met by three pumps, the possibility is remote and in any event such a fire is likely to be of greater severity than could be dealt with by a sprinkler system alone.

The break tank means preferably comprises a tank provided with a valve means operated in response to level of water in the tank, to control delivery of water from the main to the tank. Such valve means may comprise a float controlled valve or valves. The arrangement preferably provides a means whereby, as is usually required by water supply authorities, the possibility of flow back into the main, of water which has entered the tank, is eliminated.

Preferably the system includes means for providing an alarm signal in response to the operation of one or more sprinklers. Such means may comprise means for detecting a drop in pressure at a point of the system leading to one or more sprinklers, and means for detecting flow of water leading to the one or more sprinklers.

When a sprinkler operates, two conditions exist in consequence, one being a drop in pressure at the part of the system leading to the sprinkler or sprinklers and the other being a flow of water at such point at least equal to the flow through one sprinkler. When these conditions are established, the alarm

signal may be given. A call out signal may be automatically sent to the fire brigade.

Preferably the system includes means for testing its satisfactory operation. Such means for testing the system may comprise means for simulating the bringing into operation of a sprinkler and means for checking to ensure that operation of the pump means follows, as above described.

Preferably the means for simulating operation of a sprinkler comprises means for releasing water from the pipe leading to the at least one sprinkler, and preferably the water released is returned to the break tank means so that no water is wasted. The means for releasing water may comprise a valve which may be electrically controlled and remotely operable, e.g. by a suitable control circuit responsive to a signal sent by way of a signal transmission means, e.g. a telephone line. The response of the system to such release of water may be recorded and/or transmitted to another location from which operation of the system is monitored.

The invention will now be described by way of example with reference to the accompanying drawing, which is a diagram of the components and connections therebetween of a system according to the invention.

Referring to the drawing, a water main bringing water from a water supply authority is indicated at 50. A pipe 51 is branched off the main 50, and contains an isolation valve 1 followed by a non-return valve 2. The pipe extends into an enclosure or equipment cabinet or room indicated generally at 53 which contains the components described hereafter, although it will be appreciated that if desired certain components may be mounted at locations other than in the enclosure 53.

Within the enclosure, a pipe 54 connected to the pipe 52 has a monitored valve 3, a pressure sensitive device 4, a pressure gauge 5, and leads to a valve assembly for discharge of water into a break tank 8. The valve assembly for such discharge of water may comprise small and large float operated valves 6, 7. The tank 8 is further provided with water level detectors 9 and 9a which are

arranged to provide an alarm signal in the event of low or high water level in the tank 8. The tank further has a drain valve 10. The tank may provide for storage of a volume of about $2m^3$ of water.

Three pipes 55, 56, 57 lead from the tank 8 to respective booster pumps 11, 12, 13 and thence by respective non-return valves 14, 15, 16, to a manifold 58. From manifold 58 a pipe 59 having a monitored isolating valve 18 and an automatic sprinkler alarm valve 19 extends to an outlet 61 which would be connected to suitable pipework leading to one or more sprinklers. Valve 19 also prevents reverse flow in the pipe 60. Between valve 19 and outlet 61, the pipe 60 has a pressure gauge 30, pressure sensitive electrical switch 20 to provide a "low pressure alarm" signal, pressure responsive switch 21, and pressure responsive switch 22 for recording system pressure. Pressure responsive switch 21 is a switch having a "dead band" between the pressures at which it switches "on" and "off". There is further a flow rate measuring device 23 which may be a device as known by the name "Annubar" and a signal transmitter 24 associated with the flow rate measuring device 23. There is also a monitored drain valve 31. The maximum output of the three booster pumps 11, 12, 13 together is substantially not greater than the minimum sustainable flow rate of water available from the main 50 to replenish the tank 8. Such flow rate may be ascertained by enquiring of the water supply authority.

From manifold 58 there extends a further pipe 62 having a jockey pump 32 and non-return valve 33. This pipe 62 then rejoins the pipe 60 after the valve 19. A further connection to the manifold 58 is provided for fire brigade inlets 28, 29, by way of a monitored valve 27. The manifold 58 has a drain valve 17.

Between outlet 61 and the flow rate measuring device 23 a pipe 63 extends from the pipe 60 and has a motorised valve 25 and solenoid valve 26 connected in parallel with one another. From these valves, the pipe 63 leads to an outlet 64 to the storage tank 8. The pipe 63 may also have a branch 65 having a monitored valve 37, leading to waste.

Additionally shown in the drawing is, represented diagrammatically, a control panel 34. There is also an ambient temperature sensor 35 and an electrical heater 36 to warm the vicinity of the equipment above described to prevent freezing in cold weather. The control panel has associated with it suitable electrical and/or electronic circuits and devices for example including data processing means, to detect and control operation of the system components as described hereafter. Suitable indicating devices would be provided as required to indicate the status or condition of the components of the system, the pressures and/or flow rates existing at the different points of the system, and so on.

In use, provided none of the sprinklers connected to the outlet 61 is in operation and neither of the valves 25, 26 is open, jockey pump 32 operates in accordance with pressure responsive switch 21 to pressurise the pipe 60 leading to the outlet 61. A maximum water level within the storage tank 8 is established by float controlled valves 6, 7, and the system remains in equilibrium.

If one or more of the sprinklers connected to outlet 61 should be brought into operation, e.g. by the melting a fusible element in such sprinkler or sprinklers if a fire breaks out, the pressure at the outlet 61 will drop and this and the resulting flow of water to such sprinkler or sprinklers, initially provided by the jockey pump 32, will be detected by flow rate measurement device 23 and pressure switch 20. Firstly in response to such detection the effect is to bring the first pump 11 into operation, and if sufficient sprinklers are operating such that the pump 11 is not able to sustain the required flow rate and pressure at the outlet 61 the further pumps 12 and 13 are brought successively into operation. As water is drawn from the tank 8 to be thus supplied to the sprinklers, the tank is replenished from the water main supply under the control of valves 6, 7.

At the same time as pump 11 first starts to operate, a fire alarm signal is caused to be generated, which may be arranged to operate an audible alarm and/or, preferably, cause a call-out signal to be transmitted to the fire brigade.

For testing the system, a signal, which may be sent from a remote location by telephone line or otherwise transmitted, is applied to the valve 25 or

valve 26 to open it, which has the effect of simulating operation of one or more sprinklers connected to the outlet 61. Motorised valve 25 can provide a sufficient flow of water to simulate the operation of one or more sprinklers; while valve 26 can simulate operation of a large number of sprinklers, thus to test the full range of modes of operation of the system with the three pumps 11, 12, 13 successively brought into use. The water flowing through the valve 25 and/or valve 26 is returned to the storage tank 8 by way of outlet 64. The operation of the system as above described in response to opening of the valve 25 and/or valve 26 is checked.

The system may provide for the transmission to a remote location of the results of testing the system as above described, and/or recording of the testing results.

More particularly, the system may provide for the continuous monitoring of one or more of the following items:

1. The status of the mains electrical power supply to the system;
2. The state of the main isolating valve 3;
3. The settings of all pressure responsive switches in the system;
4. Whether the jockey pump 32 is running;
5. Whether each of the boost pumps 11 to 13 is running;
6. The level of water in the storage tank 8;
7. Mains water pressure;
8. The status of all electrically operable and/or monitored valves in the system;
9. The flow rate as measured by device 23.

Further additionally, there may be means for detecting and recording any entry into the enclosure 53 and/or control panel 34. The temperature sensor 35 and heater 36 may have their operation monitored, and an alarm signal may be provided if there is any danger of frost damage. There may be provided means for transmitting pre-recorded messages for communication to other

locations and/or a public address system at the site of the sprinkler system installation.

Facilities may be provided for electrical connection to other equipment at the site of the installation or at other locations, e.g. to cause shut-down of fans, conveyors, and any other electrical equipment if there is a fire hazard condition existing.

There may be facilities for evacuating air from the system, if it is one where one or more pipes leading to sprinklers are not normally full of water.

In the event of a fire breaking out, the response of a system thereto is potentially useful information for the purpose of subsequent investigations. Thus the system may also provide for monitoring and recording one or more of the following items:

1. The time of operation of the first sprinkler to operate;
2. Confirmation that the jockey pump 32 has been operating satisfactorily;
3. Confirmation that the low pressure switch 20 has operated satisfactorily;
4. Confirmation that the first and subsequent ones of the booster pumps 11 to 13 have been brought into operation, and the time thereof. This relates to the time that each sprinkler comes into operation, as the flow rate changes as further sprinklers operate;
5. The time a call-out signal was sent to the automatic 999 dialler or similar equipment;
6. The time a connection was made to the inlet 28 or 29;
7. The time any entry was made to the panel 34 for closing down the system.

All such information is additional to the regular testing carried out other than in response to the breaking out of a fire, which will confirm that the system was in satisfactory condition before the fire.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. A fire sprinkler system comprising:

means for connection to a water main, for supply of water to the system;

break tank means for receiving said water;

at least one sprinkler;

and pump means for supplying water from said break tank means to said at least one sprinkler;

wherein said pump means is arranged to be operated so as to provide for supply of water to said at least one sprinkler at a flow rate substantially not greater than a predetermined flow rate.

2. A system according to Claim 1 wherein said predetermined flow rate is a value of a sustainable flow rate of water available from the water main.

3. A system according to Claim 1 or Claim 2 further comprising means for measuring the pressure and/or flow rate of water in a pipe leading to said at least one sprinkler, and means for controlling operation of the pump means in accordance with the flow rate and/or pressure thus measured.

4. A system according to any one of the preceding claims wherein the pump means includes a pump operable to pressurise water in said pipe leading to the at least one sprinkler when no sprinklers are in operation, whereby change of such pressure in the pipe provides an indication of the bringing into operation of a sprinkler or sprinklers.

5. A system according to any one of the preceding claims wherein the pump means includes a number of pumps of which one or more are arranged to be brought into operation according to the number of sprinklers operating.

6. A system according to any one of the preceding claims wherein the break tank means comprises a tank provided with a valve means operable in response to level of water in the tank, to control delivery of water from the water main to the tank.

7. A system according to Claim 6 wherein the valve means comprises a float controlled valve or valves.

8. A system according to Claim 6 or Claim 7 further comprising means whereby the possibility of flow back into the main, of water which has previously entered the tank, is eliminated.

9. A system according to any one of the preceding claims including means for providing an alarm signal in response to the operation of one or more sprinklers.

10. A system according to Claim 9 wherein said means for providing an alarm signal comprises means for detecting a drop in pressure at a point of the system leading to one or more sprinklers, and means for detecting flow of water leading to said one or more sprinklers.

11. A system according to any one of the preceding claims further comprising means for testing its satisfactory operation.

12. A system according to Claim 11 wherein said means for testing the satisfactory operation comprises means for simulating the operation of a sprinkler, and means for checking to ensure that operation of the pump means follows said simulated operation of a sprinkler.

13. A system according to Claim 12 wherein said means for simulating operation of a sprinkler comprises means for releasing water from a pipe leading to said at least one sprinkler.

14. A system according to Claim 13 wherein said released water is returned to the break tank means.

15. A system according to Claim 13 or Claim 14 wherein said means for releasing water comprises a valve which is electrically operable.

16. A system according to Claim 15 wherein said valve is operable in response to a signal sent from a remote location by way of a signal transmission means.

17. A system according to any one of Claims 13 to 16 comprising means for recording and/or transmitting to another location in response of the system to such release of water.

18. A method of operating a fire sprinkler system comprising means for connection to a water main for supply of water to the system, break tank means for receiving said water, at least one sprinkler and pump means for supplying water from said break tank means to said at least one sprinkler; said method comprising operating said pump means so as to supply water to said at least one sprinkler at a flow rate substantially not greater than a predetermined rate.

19. A method according to Claim 18 wherein said predetermined rate is a sustainable flow rate of water available from the main.

20. A method according to Claim 18 or Claim 19, comprising measuring and pressure and/or flow rate of water in a pipe leading to said at least one

sprinkler, and means controlling operation of the pump means in accordance with the flow rate and/or pressure thus measured.

21. A method according to any one of Claims 18 to 20 comprising pressurising water in the pipe leading to said at least one sprinkler when no sprinklers are in operation, and using the change of such pressure in the pipe to provide an indication of the bringing into operation of a sprinkler or sprinklers.

22. A method according to any one of Claims 18 to 21 comprising providing an alarm signal in response to the operation of one or more sprinklers.

23. A method according to Claim 22 comprising detecting a drop in pressure at a part of the system leading to one or more sprinklers, and detecting a flow of water leading to said one or more sprinklers, to provide said alarm signal.

24. A fire sprinkler system substantially as hereinbefore described with reference to the accompanying drawings.

25. A method of operating a fire sprinkler system substantially as hereinbefore described.

26. Any novel feature or novel combination of features described herein and/or in the accompanying drawings.

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Examiner's report to the Comptroller under Section 17
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Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI AND CLAIMS

Documents considered relevant following a search in respect of Claims :-
1-25

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	US 4366865 (MAKIBBIN) see abstract and Claim 1	1

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